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3,303,531

SPINNERETTE

Joseph Ogden, Brielle, N.J., assignor to Engelhard Industries, Inc., Newark, N.J., a corporation of Delaware
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The present invention deals with a spinnerette for the extrusion of viscous synthetic substances of filament forming ability, and is concerned in particular with a spinnerette composition especially suitable therefor.

Spinnerettes for the extrusion of viscous substances in the spinning of artificial filaments, e.g. nylon, rayon, etc., usually comprise a plate in the form of a disc or cup, or the like, provided with a plurality of orifices formed therethrough and through which the viscous mass is extruded to form filaments.

In the spinning of certain artificial filaments, spinnerettes, composed of base metals such as stainless steels, have been found suitable. However, such spinnerettes are not always satisfactory under severe operating conditions and are in particular not especially suitable in the spinning of artificial filaments of synthetic polyamides and other polymerization products or fibre forming ability where spinning takes place at elevated temperatures and pressures and under otherwise exacting operating conditions resulting from the nature of the extrusion mass. Although spinnerettes of stainless steel have been found suitable where thick-walled spinnerettes are employed, e.g. in the nylon process, the spinnerettes have not been entirely free from undesirable wear and corrosion. It is a critical requirement that the walls of the orifices and especially capillary discharge orifices are smooth and that the discharge opening is in the form of a sharply defined edge in the plane of the spinnerette bottom. When such sharp edge becomes rounded or otherwise worn due to oxidation or corrosion under the influence of the high temperatures attendant with extrusion of heated synthetic viscous masses, the spinnerette must be discarded and scrapped because the filaments no longer are uniformly extruded.

Furthermore, the polished surface of the orifice walls and the sharp contour of the outlet orifice edge are subjected to the abrasive action of certain types of treated yarns, especially those known as dull yarns, and may otherwise be deleteriously affected by the cleaning processes at even higher temperatures, whereby the life of the spinnerette becomes limited or otherwise abnormally decreased.

It is an object of the present invention to provide a spinnerette characterized by a longer life under adverse spinning conditions than that of spinnerettes heretofore known.

It is another object of the present invention to provide a spinnerette which shall be suitable for the spinning of artificial filament and the like from synthetic materials under substantial extrusion pressures.

It is a further object of the present invention to provide a spinnerette which is resistant to abrasion and substantially free from corrosion, erosion and oxidation at elevated temperatures, and especially substantially free from such corrosion, erosion and oxidation at critical portions of the extrusion orifice.

Other objects and advantages of the invention will appear from the description hereinafter following.

According to the invention, there is provided a spinnerette having extrusion orifices of the type disclosed in U.S. Patents No. 2,362,277 and No. 3,049,753 and composed of an alloy containing essentially nickel and chromium, with the nickel and chromium content being substantially higher than that of conventional stainless steel spinnerettes. The alloy may also contain small amounts

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of sulphur, silicon, copper aluminum and titanium so long as it contains 19% and more of chromium and 30% and more of nickel. Generally, the alloys of the invention contain essentially from 19% to 35% chromium and 30% to 65% nickel with 0% to 1.5% manganese, 0% to 0.10% carbon and 0% to balance iron. It will be noted that this range induces an alloy composition consisting of 65% nickel with 35% chromium. Other preferably alloys within the composition range include the alloys 19%–22% chromium, 30%–34% nickel, 0.10% carbon, 1.5% manganese, 0.03% sulphur, 1.0% silicon, 0.50% copper and balance iron. Also, another preferred alloy composition is 30% chromium, 41% nickel, 0.02% carbon, 0.86% manganese, 0.39% copper, 0.38% aluminum, 0.50% titanium, and balance Fe.

These alloys are reproduced as alloys A, B and C as follows:

(A) 19%–22% Cr, 30%–34% Ni, 0.10% C, 1.5% Mn, 0.03% S, 1.0% Si, 0.50% Cu, and balance Fe.

(B) 30% Cr, 41% Ni, 0.02% C, 0.86% Mn, 0.39% Cu, 0.38% Al, 0.50% Ti, and balance Fe.

(C) 35% Cr and 65% Ni.

There are stainless steel alloys outside the scope of the invention which are useful for spinnerettes for the spinning of artificial filaments at elevated temperatures and pressures. For example, such spinnerettes are composed of stainless steel alloys identified below as follows:

(D) 24.7% Cr, 4.6% Ni, 0.13% C, 1.04% Mn, 0.015% P, 0.008% S, 1.2% Si, 0.35% V, and balance Fe.

(E) 16%–18% Cr, 10%–14% Ni, 0.10% C, 2.0% Mn, 2.3% Mo, 0.04% P, 0.03% S, 1.0% Si, and balance Fe.

(F) 17%–19% Cr, 8%–10% Ni, 0.15% C, 2.0% Mn, 0.60% Mo or Zr, 0.07% Se, P, or S, 1.0% Si, and balance Fe.

It will be noted that alloys A, B and C contain 19%–35% Cr and 30%–65% Ni, while alloys D, E and F contain 16%–24.7% Cr and 4.6%–14% Ni, or otherwise stated, the combination of Cr and Ni in alloys A, B and C are in the range of 40% to 100%, while the combination of Cr and Ni in alloys D, E and F are in the range 20.6%–38.7%.

It has been found that alloys A, B and C are characterized by the desirable spinnerette qualities of excellent resistance to corrosion, high hardness and therefore good resistance to erosion, high yield strength, i.e., high resistance to bulging under high temperature and pressure spinning conditions and good machinability, thereby enabling the formation of high quality walls of the spinnerette orifices. While alloys D, E and F are somewhat acceptable as to some of the above-mentioned qualities, they are quite inferior to alloys A, B and C in resistance to corrosion.

Resistance to corrosion is a critical requirement for spinnerettes, especially those having orifices with diameters of from about 0.003 inch to about 0.0625 inch with lengths of from about 0.005 inch to about 1.0 inch, because after use the spinnerettes have to be cleaned to remove accumulated deposits which would otherwise affect the uniformity of the extruding filaments. In the cleaning operation the spinnerettes are subjected to severe corrosive conditions such that a metal weight loss occurs and such weight loss under repeated cleanings is detrimental for the maintenance of uniform capillary or orifice dimensions. While stainless steel spinnerettes may still be useful when subjected to a few cleaning cycles, they ordinarily have to be repaired after such few cleanings because of the damage to the hole. The spinnerettes of this invention have been found to have a surprisingly low weight loss and no apparent hole damage even after a great number of cleaning cycles in

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comparison with the conventional stainless steel spinnerettes.

The spinnerette cleaning process mentioned was conducted with the severe cleaning cycle of immersing the spinnerette in a salt bath at 900° F. for 30 minutes as one stage of the cycle and boiling the spinnerette in boiling 42° Baumé nitric acid bath for 30 minutes. Temperatures and time may vary and the stages may be substituted one for the other.

The following tabulation shows the comparison of the weight loss of spinnerettes of the invention in comparison with alloys D, E and F spinnerettes in the cleaning process.

CUMULATIVE WEIGHT LOSS MG./IN.² vs. CLEANING CYCLES

Alloy	Cycles							
	1	2	8	16	20	30	40	50
A.....	.97	1.68	3.39	7.36	8.22	10.1	11.7	12.7
B.....	.47	.89	2.05	6.39	7.01	11.3	14.0	15.5
C.....	.36	.81	3.07	6.42	8.57	15.1	19.4	24.0
D.....	.72	1.28	6.20	12.7	18.7	45.1	82.0	119.0
E.....	.73	1.32	6.44	14.8	18.5	34.0	66.0	130.0
F.....	2.4	5.4	11.0	26.6	30.4	68.0	114.0	215.0

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From the above tabulation it will be seen that the spinnerettes of the present invention is an improvement over conventional stainless steel spinnerettes.

What is claimed is:

1. A spinnerette for the extrusion of viscous substances in the spinning of artificial filaments comprising a disc having a plurality of orifices formed therethrough, the disc being composed of an alloy containing essentially 30%–65% Ni, 19%–35% Cr, and including from 0%–0.10% C, 0%–1.5% Mn, 0%–0.03% S, 0%–1% Si, 0%–0.50% Cu, 0%–0.38% Al, 0%–0.50% Ti and 0%–balance Fe.

2. A spinnerette composed of an alloy of 65% Ni and 35% Cr.

References Cited by the Examiner

UNITED STATES PATENTS

1,887,190	11/1932	Twiss et al.
1,990,277	2/1935	Feussner et al.
2,058,670	10/1936	Doobar.
2,085,532	6/1937	Kinsella.
2,362,277	7/1944	Jones.

WILLIAM J. STEPHENSON, *Primary Examiner*.